

Durham Research Online

Deposited in DRO:

02 February 2012

Version of attached file:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Sawdon, M. and Finn, G. and Griksaitis, M. and Kirkman, E. (2011) 'Simulating haemorrhage in medical students using a lower body negative pressure chamber : measuring the consequences for tissue oxygenation.', Association for Simulated Practice in Healthcare (SESAM) 2011, Society in Europe for Applied Simulation Conference. Granada, Spain, 2-4 June 2011.

Further information on publisher's website:

<http://www.sesam-web.org/meetings/sesam-annual-meeting-2011/>

Publisher's copyright statement:

Additional information:

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in DRO
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full DRO policy](#) for further details.

**Title: Simulating Haemorrhage in Medical Students using a Lower
Body Negative Pressure Chamber; Measuring the Consequences for
Tissue Oxygenation**

Authors:

Dr Marina Sawdon BSc (Hons) PhD

Lecturer in physiology, School of Medicine & Health

Durham University, Queen's Campus

Ms Gabrielle Finn BSc (Hons)

Lecturer in anatomy, School of Medicine & Health

Durham University, Queen's Campus

Dr Michael Griksaitis MBBS(Hons) MRCPCH PGCertMedEd

SpR Neonatology, Neonatal Intensive Care Unit

James Cook University Hospital

Dr Emrys Kirkman BSc (Hons) PhD

Honorary Senior Lecturer, School of Medicine & Health

Durham University, Queen's Campus

Correspondence:

Dr Marina Sawdon

Phase 1 Medicine

University of Durham, Queen's Campus

University Boulevard

Stockton-on-Tees

Cleveland

TS17 6BH

Email marina.sawdon@durham.ac.uk

Tel +44 191 3340340

Fax +44 191 3340321

KEYWORDS:

Ultrasound

Haemorrhage

Simulation

Oxygenation

Abstract

Introduction This article is a descriptive report of a novel way of demonstrating the cardiovascular response to progressive haemorrhage using simulation.

The aim of the simulated haemorrhage is to improve the understanding of the cardiovascular response to haemorrhage and demonstrate 'live' the body's response to reduced venous return.

Method Phase 1 of a 'simple' haemorrhage is simulated in 6 medical students by applying sub-atmospheric pressure to the lower body using a lower body negative pressure (LBNP) chamber. The sub-atmospheric pressure causes 'pooling' of blood in the vessels of the legs and pelvis, which reduces venous return thus mimicking the

effects of haemorrhage. Parts of this method have been described elsewhere (1). A range of cardiovascular parameters are monitored throughout the demonstration to allow students to observe the integrated response to 'progressive haemorrhage'. Stroke volume is monitored using a portable ultrasound machine, heart rate is measured from an ECG trace and blood pressure using an automated sphygmomanometer. Skeletal muscle and brain oxygenation, which in this context reflects changes in blood flow, is assessed using Near Infrared Spectroscopy (NIRS).

Results Simulated haemorrhage reduces venous return, thus reducing stroke volume by Starling's law of the heart (2) and ultimately reduces arterial pulse pressure. The body's initial response (mediated by the baroreceptor reflex) to this is an increase in heart rate to maintain mean blood pressure (3) in the face of a falling cardiac output. The students also calculate the changes in total peripheral resistance and are able to see the consequences for brain and skeletal muscle oxygenation.

Conclusion Durham University Medical Programme uses simulation in a novel way to reinforce didactic teaching of the cardiovascular response to haemorrhage utilising a LBNP chamber.

Word count 248

References

1. Sawdon M & Kirkman E. Simulating Haemorrhage in Medical Students. *International Journal of Clinical Skills*. 2008; **2**(2): 74-78.
2. Patterson SW, Starling EH. On the mechanical factors which determine the output of the ventricles. *Journal of Physiology*. 1914; **48**(5): 357-379.
3. Sawdon M, Ohnishi M, Watkins P & Kirkman E. The effects of primary thoracic blast injury and morphine on the response to haemorrhage in the anaesthetised rat. *Experimental Physiology*. 2002; **87**(6): 683-689.